

Conservation of butterflies in Australia

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Abstract. The development of understanding of butterfly conservation in Australia is reviewed. A summary is given of the dramatic changes to Australian terrestrial environments which have occurred since Caucasian settlement, and some factors leading to butterfly decline in recent years are itemised. The study of Australian butterflies is summarised, and the limitations of current knowledge in relation to conservation concern are stressed. Recent legislative measures involving butterflies are itemised and discussed. Species-orientated conservation cases are still rare, but the roles of several taxa in increasing political and public conservation awareness are outlined.

Introduction

"Butterfly Conservation" is a relatively new topic in Australia, and has not yet developed to encompass the broad public and scientific concern it engenders in much of the northern hemisphere. However, during the last few years it, together with other aspects of invertebrate conservation, has started to appear on scientific and political agendas as part of a growing more general concern over the future of the Australian environment and biota. A preliminary report on conservation status of Australian insects by Key (1978) aroused considerable interest. A broader appraisal (New 1984) and a number of other accounts and surveys have been published during the last decade, and many of these are noted below.

Thus, in contrast to the more detailed historical and factual treatments which are feasible for butterfly conservation in Europe or North America, where this theme has long been accepted readily, this account traces the emerging awareness of the topic and how it is gradually becoming acknowledged as important in Australia. Specific case histories are sparse, and there is thus not a "bank" of experience of conservation of particular taxa equivalent to that available for parts of the northern hemisphere. This account must, in contrast, indicate some of the principles, restrictions, and increasing public and legislative sympathy for butterfly conservation in the country.

The Problem

The Australian environment has been changed dramatically during only 200 years of European settlement, and much of the indigenous biota of the island continent has suffered accordingly. The major change has undoubtedly been the destruction of natural vegetation, and related effects. Vast tracts of land have been cleared for pasture and arable agriculture, so that most categories of forest and woodland have declined.

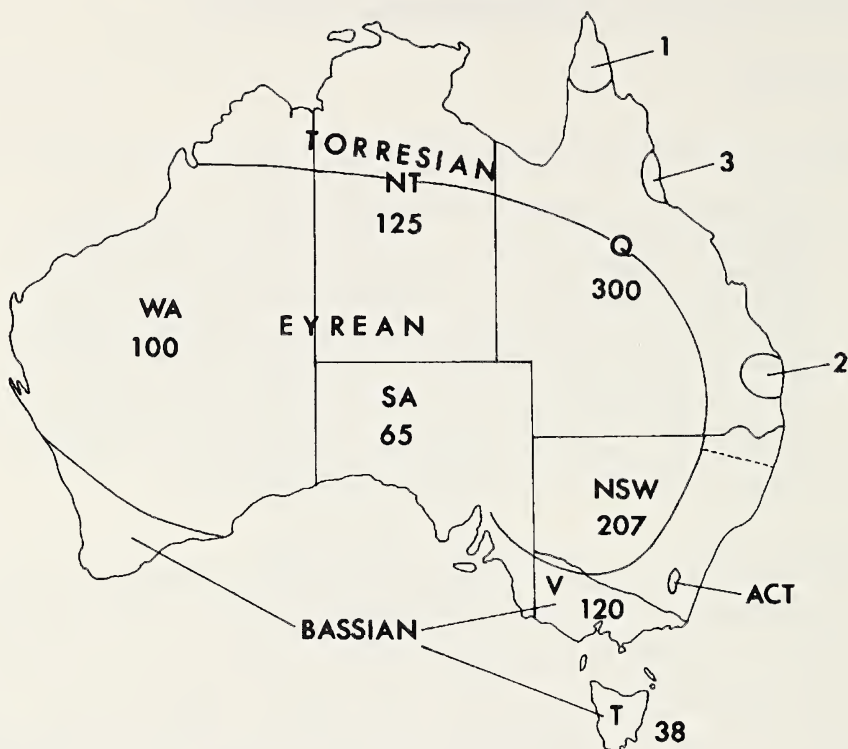


Figure 1. Australia, indicating major political boundaries, biogeographical regions, approximate numbers of butterfly species from each State and Territory, and some major centres of butterfly diversity. States and Territories denoted by initial letters (Western Australia, Queensland, New South Wales, Victoria, South Australia, Tasmania, Northern Territory, Australian Capital Territory); numbers of butterfly species summarised from Common & Waterhouse (1981) and more recent literature; centres of diversity shown are (1) Cape York Peninsula, (2) southern coastal Queensland, (3) Cairns area - after Kitching (1981), see text; the regions shown are the southern Bassian, with distinct Western and Eastern Provinces, the Torresian (northern and north eastern), and the more arid Eyrean, delimited by the 500mm isohyet. The northern boundary of the East Bassian is debatable, and there are frequent northward incursions of southern fauna at higher altitudes.

Only small proportions of the original vegetation remain in some major grain-growing areas (such as parts of Western Australia and South Australia), and nearly three-quarters of forests in Victoria have been modified substantially, for examples. As much as half the continent may have suffered degradation in land quality (Ive and Cocks 1989) by loss of topsoil resulting from combinations of vegetation clearing, over-cultivation, overstocking, irrigation and the activities of feral exotic animals -

ranging from rabbits and goats to horses, camels and water-buffalo. A second category of change considered also to have affected insects adversely has been the introduction of large numbers of exotic animals, including the above and other mammals, birds, freshwater fish and the cane toad (*Bufo marinus*) as well as an array of arthropods, including non-specific biological control agents, and aggressive plant weeds.

Urbanisation in Australia, with its attendant effects, has tended to be concentrated along the eastern side and the southern corners of Australia, the areas of greatest rainfall and ecological complexity (Fig. 1). Much of the vast semiarid to arid inland region, in contrast, is very sparsely settled, although still subject to grazing by stock, and related degradation pressures.

It is reasonable to infer that the above, and other, changes have caused decline and/or loss of many insect taxa, but this is difficult to substantiate because of lack of historical information on most groups. For many insect orders, there are still large numbers of unnamed species, and many taxa have yet to be collected and categorised; this lack of knowledge, with perhaps only half our insect species, or even less, yet having names, constitutes a substantial "taxonomic impediment" (Taylor 1976) to communicating concern about loss of insect diversity. As they are elsewhere, butterflies are one of the best-known groups of insects, and attention is now being paid to both the wellbeing of individual taxa, and to their use as indicators of a greater conservation need: as reflections of invertebrate biodiversity and thus of the "health" of natural environments.

However, Australia, even neglecting various political outliers, is a vast area, and there are many gaps in distributional and faunistic knowledge even for such "well-known" groups. The continent spans a wide range of environments, from lowland tropical rainforest in the north, through arid regions and cool woodlands, to cold montane environments in the southeast, and this mosaic of environments can be used to provide foci for insect conservation in various ways. A general account of some of the problems involved in planning conservation of the fauna is given by Greenslade & New (1991).

Australian butterflies, and their study

In contrast to many groups of the 20,000 or so species of moths in Australia the butterflies are, in general, taxonomically tractable and most of the nearly 400 species are recognisable without difficulty. A recent handbook (Common & Waterhouse 1972, 1981) marks the zenith of a series of texts produced at intervals over the previous century. The most important of these are a Catalogue by Masters (1873, noted by Moulds, 1977, as the first book wholly on Australian butterflies), Olliff (1889), Anderson and Spry (1893-94), Rainbow (1907) and two later classics still of great value: Waterhouse & Lyell (1914) and Waterhouse (1932). With the stimulation to collectors and biologists provided by

these and more recent texts (McCubbin 1971, D'Abrera 1971 and later editions) and a number of less comprehensive volumes, a useful framework of distributional, taxonomic and biological information on Australian butterflies now exists, leading to possibility of some generalisation over faunal composition and larval food-plant associations (Symons 1980), for examples. More research than ever before is currently being pursued on butterfly biology in Australia and representatives of many endemic genera have been studied in considerable detail during the last decade or so.

It is likely that a few further species of HesperIIDae and LycaenIDae will be found in less extensively collected regions, and that the taxonomic status of members of some complexes of putative subspecies will also change. Otherwise, very few species are undescribed. As with many other insect groups in Australia, endemism is high, so that there are some very characteristic elements in the fauna. The butterflies of northern Australia have much in common with those of New Guinea and many non-endemic taxa are restricted, or largely restricted, to this warmer region. They represent an attenuation from the richer faunas of New Guinea and the Indo-Malayan fauna. A few species are widely distributed elsewhere: *Danaus plexippus* (L.) (which has been in Australia for about 100 years), *D. chrysippus petilea* (Stoll), *Lampides boeticus* (L.) and *Pieris rapae* (L.) are the best-known. The most characteristic endemic complexes occur in the HesperIIDae: Trapezitinae, NymphalIDae: Satyrinae, and LycaenIDae: Theclinae and Polyommatinae, and these groups contain a very high proportion of the butterflies of conservation concern. Others occur. Several PapilionIDae, for example, have been considered in conservation legislation (see below). In general, there is a tendency for endemism at both generic and specific levels to be highest in the southern regions of Australia, probably reflecting a longer history of evolutionary isolation as relatively earlier arrivals than most butterflies now confined to the North. Torres Strait, between New Guinea and Queensland, may have existed for only some 5.5-6 thousand years, before which these areas were contiguous. Many of the least tractable groups of butterfly species or putative subspecies occur in the south, indicating that speciation is continuing. Many of them have very localised distributions and some are known to have declined in distribution range. Thus, for example, the island State of Tasmania has only three endemic species and one endemic genus (all Satyrinae) but many endemic subspecies (Couchman & Couchman 1977). Some other Tasmanian subspecies are shared only with southern Victoria. Figure 1 shows the main political areas of continental Australia with indications of the relative diversity of butterflies in each, together with major biogeographic zones.

Butterfly diversity is generally highest in the east, and decreases rapidly to the west of the Great Dividing Range. Major coastal centres of diversity (Fig. 1) include (1) the northernmost part of Queensland, Cape York Peninsula, with the most diverse array of Australian butter-

flies, around 140 species (Monteith & Hancock 1977), (2) an area in southern Queensland where there is strong overlap of northern and southern faunas (Kitching 1981), and (3) the area around Cairns, between these two, which Kitching (1981) emphasises has been subject to especially high collecting intensity over many years. In contrast, butterfly diversity is generally low in the arid interior of the continent, and few endemic taxa occur there. Many of the Northern Territory taxa, for example, are restricted to the more clement climate of the "Top End." Only some 40 species occur towards the south of the Territory in the centre of the continent. Because of their degree of taxonomic isolation, many Australian butterflies are readily designatable as worthy species for conservation attention when their restricted habitats are perceived to be threatened, or are known to be declining.

The gross distributional ranges of many species are known, and distribution maps for each species and subspecies are included in Common & Waterhouse (1981), but the "fine grain" distribution of most is by no means clear and collectors continue to record taxa from up to hundreds of km outside their earlier-recorded ranges.

Many species are known from only very few localities, some from only single small colonies occupying very restricted areas. In some instances there is little apparent reason for this as the habitats appear to be enclaves within much larger areas of seemingly similar terrain and vegetation. In others, restricted distributions are related more clearly to foodplant availability or to altitude or other physical features. A number of southeastern Satyrinae, for example, are alpine or subalpine and restricted to rather precise altitudinal ranges in the small mountainous regions. They often occur as discrete colonies on different mountains widely separated from each other by lower land, and some such isolated populations have been accorded subspecific names.

As in other parts of the world, the species of direct conservation concern tend to be those whose abundance or distribution has either been reduced by human activities or where this is considered likely to occur. They encompass widespread species which are decreasing in abundance and species which are known from few sites, so that "more general" and "more specific" threats are both relevant. The latter could result in rapid extinctions but there are few documented cases of this in Australia.

There has never been a large population of butterfly hobbyists in Australia, and yet much of our knowledge and the bulk of collections in major institutions derives from their activities. Together these collections comprise a very substantial data base which is being progressively recorded and assessed with the aim of refining knowledge of butterfly distributions and how these may have changed in relation to land use. This is being augmented by increased and more selective survey and/or collecting in little-studied areas of several States to increase knowledge of some critical species. It will clearly be a long time before detailed distributional knowledge is relatively complete and lack of this definitive

information (in comparison with, particularly, some parts of Europe) is a communication hindrance with decision-makers in promoting cases for the conservation need of particular taxa. Formalised distribution data are not yet sufficiently comprehensive, in general, to be persuasive to people seeking information on the detailed status of particular butterflies or to reinforce claims that particular butterflies "only occur" in a stated place and this, coupled with taxonomic uncertainty over the precise status of particular populations, weakens the case for some single-species conservation efforts. Most collectors reside on the eastern coastal part of Australia or in the southwest corner, the areas of greater butterfly diversity and greatest concerns over environmental effects on the insects. Some other parts of the continent are still relatively inaccessible and the total area needing detailed survey is, indeed, enormous.

Perhaps the most intensively - collected area of mainland Australia is Victoria, currently subject to a butterfly mapping scheme (ENTRECS) operated by the Entomological Society of Victoria. On a relatively crude 10 x 10 minute grid system (defining areas of about 15 x 18 km), only about half these areas in the State (one of the smallest) have *any* butterflies formally recorded from them, and very few are comprehensively known (ESV 1986). Victoria contains only about 120 species of butterfly, about 10 being recorded there for the first time during the last decade. Maps for rainforest butterflies in New South Wales (Nadolny 1987) emphasise known distributions, again often sparse, of species of conservation interest, and more extensive survey work is currently in progress for that State. A list for the Australian Capital Territory (Kitching et al. 1978) also cites localities for that restricted area. A wider scale distribution - recording scheme for butterflies in Australia is also current (Dunn & Dunn 1990), but the prospect of providing detailed distribution maps for most butterflies over the vast areas of the larger Australian States is not realistic at present. There is need for decision-makers to accept the impracticality of doing this, or of being able to emulate various European mapping-schemes with very limited logistics and interest, and to accept the opinions of knowledgeable lepidopterists on the status of most species rather than insist on quantitative information.

Protective Legislation

The Legislative system in Australia is two-tiered, involving Federal and State Governments. In general, the former lacks power to over-ride a decision made by a State Government, and States with a common border may have very different environmental protection laws. Insects have received little specific attention. Butterflies have generally been included, with other invertebrates, under such general terms as "wild-life" or "fauna" and it is only recently that such designations have diverged in functional interpretation from "vertebrates." In all States and Territories, insects are protected in National Parks, and sometimes

other categories of reserves, and permits are needed to collect or study butterflies in such areas.

Australia is a signatory to CITES, although no Australian butterflies are included in Appendix 1. Export permits are needed for any Australian native fauna under the Wildlife Protection (Regulation of Exports and Imports) Act 1982. The operation of this Act is discussed by Monteith (1987), who emphasises that there has never been any significant amount of exploitative butterfly collecting in Australia for export. This is thus of little conservation concern at present but, clearly, could increase. There is little doubt that some species could in principle be endangered by unscrupulous collecting, and the Entomological Society of Victoria (the largest group of amateur entomologists and hobbyists in the country) has listed several species under a Voluntary Restricted Collecting Code, whereby no more than two adult specimens should be taken by any one collector in a season; this is, in general, heeded responsibly. Some desirable skippers could be overcollected, as their larvae produce conspicuous leaf-shelters which can be systematically taken. Some ant-attended Lycaenidae, including rare species of *Ogyris* Westwood, are traditionally collected in the pupal stage which occurs under the loose bark of eucalypts. Many collectors of such groups are tempted to take a surfeit of specimens to compensate for anticipated loss of specimens from parasitisation, and there are unconfirmed suggestions that this form of collecting has led to some rare species becoming endangered, or even locally extinct.

Until recently, the only butterflies formally "protected" (that is, which collectors are prohibited from taking!) in any part of Australia were *Papilio ulysses joesa* Butler and species of *Ornithoptera* in Queensland, designated under the Queensland Fauna Protection Act in 1974. The Queensland Act, incidentally, defines "fauna" as only indigenous birds and mammals plus other species specifically declared to be "fauna" by government decree - so that Ulysses and the birdwings had to be specifically declared to have this status! Permits are needed for capture of any individuals of these taxa in the State, and a compulsory royalty of A\$20/specimen was introduced. Several collectors have indeed been prosecuted for transgressing this legislation. Proposals were made in 1980 to have a number of insects, including the butterflies *Ornithoptera richmondia* (Gray), *Euschemon rafflesia* (Macleay), *Argyreus hyperbius inconstans* (Butler) and *Tisiphone abeona joanna* (Butler), listed for legislative protection in New South Wales under the State's National Parks and Wildlife Act. After considerable debate, and objections from sections of the entomological community (who were not consulted over the earlier Queensland legislation but opposed it strongly in retrospect), the New South Wales proposals were withdrawn.

The arguments mounted against this proposed legislation included (1) that the species appeared not to have been selected as priority taxa by any scientific process, but as examples of a much larger range of notable

insects in New South Wales many of which were at least equally deserving of protection; (2) that the conservation status of the nominated species was not clear but some, at least, appeared not to need such legislation which could merely serve to increase their value in the perception of collectors; (3) that such legislation without any concomitant provision for habitat protection/preservation or ecological study of the species involved was little better than a token gesture, and (4) that it could be extremely difficult to enforce. More particularly for the non-butterflies proposed, several species were sufficiently similar to other, non-protected, species that they could be differentiated confidently only by detailed examination, and it would not be reasonable to expect field wardens to be able to do this. In general, habitat protection was seen as far more urgent, significant and worthwhile than legislation of this sort. Many people have emphasised that the Queensland habitats for *P. ulysses* and *Ornithoptera priamus* (L.) are well-represented and that the species are not uncommon. Indeed, *P. ulysses* has recently extended its range into various towns and suburbs where its food plants have been planted.

No other State has had butterfly listings equivalent to the above, although some other insects are legally protected in Western Australia and Tasmania. Recent pioneering legislation in Victoria has specifically provided for invertebrates (and non-vascular plants) under the Flora and Fauna Guarantee Act, 1988, which in emphasis is more akin to the U.S. Endangered Species Act. Nominations can be made of any taxon deemed worthy of conservation or believed to be in need of it, and an interim conservation order may then be issued to protect the taxon and its habitat (for example, from any urgent threat of development or despoliation) pending investigation of its conservation status. The nomination process is simple and does not require massive documentation. The onus for subsequent investigation of conservation need falls on the State Ministry, together with the duty to formulate a management plan if a conservation need is indeed demonstrated. Several Lycaenidae perceived as endangered from particular development projects, such as mining exploration and urbanisation, have been nominated for listing (together with other insects) and it remains to be determined whether or not this legislation will be logistically swamped in its undertaking to ensure that "no native animal or plant will be allowed to become extinct in Victoria." It is as yet too early to comment on the functioning of this Act, which is being watched with keen interest by many conservationists in Australia. Such increased legislative awareness for insects (and other invertebrates) has the potential to draw considerable attention to the content of the modified form of the European Charter on Invertebrates which was adopted in Australia in July 1989. The Australian Entomological Society has long had an active Conservation Committee which maintains a watching brief on any such developments and seeks to foster awareness of the importance of invertebrates in conservation activity.

A recent legislative step in Australia has been to designate a species of butterfly in Queensland as "Permanently Protected Fauna" in that State, a status which confers a very high degree of protection and which has typically been accorded only to "high profile" vertebrates such as koala and platypus. Specimens held in the State by collectors, regardless of when captured, may be forfeit.

Acrodipsas illidgei Waterhouse & Lyell (see below) was gazetted on 21 July 1990 as the first insect to be declared Permanently Protected Fauna ("PPF"). Owners of specimens held in private collections *may* be given permission to retain these under a Permit to keep Fauna, renewable annually at a cost of \$20, but are the permanent property of the Crown. The permit specifies the premises at which the specimen(s) is/are to be held and separate Movement Permits (\$10 each) are needed to allow movement of specimens to other premises or in or out of Queensland. Maximum penalties specified for illegally collecting PPF are "200 penalty units or 2 years imprisonment, or both" and for "illegal possession" are "100 penalty units or 12 months imprisonment or both." *A. illidgei* had been cited, *as an example only*, of a notable insect in a general document on the State of the Environment in Queensland (1990) and seemingly should have no greater conservation priority than very many other Queensland insects: it is not clear why it was selected for such special treatment.

Priority species for Conservation

No regional Red Data Book or similar full register of species of conservation interest has been produced for Australian insects and the prospect of doing this is remote. Nine Australian insects are included in the IUCN Invertebrate Red Data Book (Wells *et al.*, 1983): no butterflies are noted. However, two documents published in 1988 do list Australian butterflies with implications for priority in conservation assessment. The more widely-known (IUCN 1988) includes seven taxa (Appendix 1), six of them from Tasmania, so that there is a strong bias towards evaluation of that island State to the relative neglect of the mainland. All six Tasmanian forms were categorised as "indeterminate," and the unusual mainland skipper *Euschemon rafflesia* as "insufficiently known."

A broad survey of insect taxa meriting conservation attention in Australia by Hill & Michaelis (1988) involved requesting relevant opinion and information from more than 600 entomologists in the country. The 54 responses collectively listed 61 butterfly taxa and it is notable (in view of the Queensland legislation noted earlier) that no Papilionidae were nominated.

The six Tasmanian taxa of the IUCN list appear also on the Hill & Michaelis list, although *E. rafflesia* does not. The latter list includes 28 other HesperIIDae, 24 Lycaenidae, 7 Nymphalidae and 2 Pieridae, some from only parts of their range. A select list of threatened taxa included 23 of these butterflies, and enumerated the perceived threats to these.

They include fire and agricultural activity (including trampling by stock), roadworks, urbanisation, mosquito control by insecticides, sand mining and bauxite mining. The most frequently cited threats are some form of "clearing" (10 species), followed by fire (7), the latter reflecting concern over vulnerability of remnant habitats even for a biota generally believed to be well-adapted to withstand low intensity fires as a sporadic natural occurrence.

The citation of "roadworks" for four species emphasises the extreme vulnerability of several small and highly localised populations. *Hypochrysops piceatus*, Kerr, Macqueen & Sands (Lycaenidae), for example, is known to be extant in only one roadside habitat (extending for about 200 m) in Queensland and could seemingly be eradicated merely by injudicious road-widening or careless use of a bull-dozer in a rather remote area. It has apparently already become rarer because of tree removal. Urbanisation effects, including direct habitat destruction, are considered likely to be important for some remnant populations of formerly more widespread taxa. The reference to mosquito-spraying is to *A. illidgei*, which is restricted to a few coastal mangrove areas in Queensland. However, many other butterflies may also have declined, and their increasing rarity and vulnerability increases their priority for conservation in many forms of such comparative assessment. Although the taxa listed by IUCN (1988) have not had their precise status formally determined, suggestions from knowledgeable collectors imply that several of these, and others, should be regarded as being in the priority categories "Endangered" or "Vulnerable."

Species-orientated Conservation

A few such localised taxa have recently been the targets of efforts to determine their status more precisely, or to more clearly appraise their need for conservation. Species-orientated butterfly conservation programmes are still a novelty in Australia, and the few cases have involved localised taxa coupled with an imminent perceived threat, that is "crisis-management" conservation with its attendant emotion. Little was known of the detailed biology of any of these species until their profiles were raised in this way. One case, in particular, has been very important in helping to establish the acceptance of butterfly conservation in Australia.

This is the Eltham Copper, *Paralucia pyrodiscus lucida* Crosby (Lycaenidae). In 1951, a brightly coloured form of the Dull Copper, *P. pyrodiscus* (Rosenstock), from outer northeastern Melbourne (Victoria) was described as distinct (Crosby 1951). It had been captured in reasonable numbers over a small area since about 1938, but declined substantially during the 1950s as its habitats became overtaken by the urban sprawl, and was presumed to have become extinct near Melbourne by about 1960. In early 1987, a large and apparently thriving colony was discovered at Eltham, within the historical range of the butterfly (Braby

1987, 1990), and on land imminently threatened with development as a housing estate. An approach to the State Minister for Conservation, Forests and Lands led to discussion with the developers, who agreed to a moratorium on development until it was determined whether it might be possible to raise funds to purchase and reserve the habitat. No precedent for this had occurred in Australia and the discovery occurred, fortuitously, during the formulation of the State's Flora and Fauna Guarantee (see above). The case was widely viewed as a barometer of the Government's sincerity in adopting invertebrates as conservation targets.

A major public appeal was launched to raise funds. The butterfly became known as the "Eltham Copper," after the township where it was discovered, one with a strong tradition of conservation and environmental awareness. It became a familiar sight on posters, T-shirts, jewellery, bumper-stickers and as a local emblem. During Australia's bicentenary year, "buy the butterfly a birthday" became a popular slogan for the appeal, and general awareness of butterfly conservation was fostered by a small booklet (New 1987) sold for the appeal. Over A\$425000 was raised, of which the State Government contributed \$250000 and the Shire Council a further \$125000.

Concurrently with the appeal, a detailed search for other colonies was pursued (Crosby 1987), a tentative management plan formulated (Vaughan 1987, 1988), and the integrity of the subspecies further appraised. Isolated colonies in one locality each in central and western Victoria, both widely separated from the Eltham population, are currently referred to the same subspecies but all other colonies, mainly further east, are believed to be the nominate form. Ten colonies were discovered around Eltham, eight of them very small and considered unlikely to be viable in the long term. The largest colony, on the subdivision land, contained an estimated 300-500 larvae but, at the other extreme, only six butterflies were seen at the smallest colony.

Management recommendations for these remnant urban populations, contingent on habitat reservation, included (1) protection from the various threatening processes created by nearby development (such as garbage dumping, sillage, trampling, slashing or burning vegetation, weed invasion, activities of domestic animals), (2) provision for habitat expansion by promoting natural regeneration of foodplants (a stunted dwarf form of *Bursaria spinosa*) and (3) provision of a ranger to foster practical management and monitor its effects. A major part of the prime colony habitat was designated for purchase in 1989, and the effect of this was augmented substantially by the State Government transferring an area of land adjacent to this, and which also supported another major colony, to constitute part of the butterfly reserve.

In the wake of the "Eltham Copper issue," attention has since been paid to several other butterflies in eastern Australia. One of its closest relatives, the Bathurst Copper (*P. spinifera* Edwards & Common), was

considered even more vulnerable (Nadolny, 1987: "the most vulnerable species in N.S.W.;" Kitching & Baker, 1990: "Australia's rarest butterfly") and until very recently was known from only a single colony in New South Wales. Its status is at present being investigated in more detail, but its whole known distribution falls inside a circle of about 18 km diameter (Kitching & Baker, 1990). The localised coastal populations of *Acrodipsas illidgei* in Queensland occupied mangroves subject to clearing for tourist resort development, and its presence was instrumental in helping to prevent development of some 160 ha near Redland Bay (Samson 1989).

As elsewhere, taxonomic problems can hamper assessment of conservation status of given populations. The Yellowish Skipper (or Altona Skipper), *Hesperilla flavescens flavescens* Waterhouse, has until recently been believed to be restricted to a few swampy areas in western Victoria, with largest colonies of this extreme bright phenotype predominantly on two sites west of Melbourne, where the sole larval foodplant (the sedge *Gahnia filum*) grows. These sites have been threatened with industrial despoliation and urban development, and these factors have been implicated in the decline of the butterfly and the loss of at least one colony. This taxon appears to be one extreme of a cline involving the highly variable *H. donnyssa* Hewitson, which has nine named subspecies and with which *H. flavescens* Waterhouse was formerly included. A recent survey by Crosby (1990) has shown that some other populations are indeed close to, if not identical with, *H.f. flavescens*, although the Melbourne colonies are closed populations and considered to represent a critical stage in speciation in this complex of skippers.

This example, and the Eltham Copper, together illustrate problems of promoting species conservation in Australia. We are commonly dealing with discrete and vulnerable populations, but ones whose taxonomic status is controversial, will be difficult to clarify, and about which specialists will continue to debate. Lack of "firm" taxonomic status of such clinal variants tends to weaken the political case for conservation. Two further examples, both taxa included in the Hill & Michaelis (1988) "threatened" list, illustrate this further.

a) *Tisiphone abeona joanna*, one of eight named "races" of the Swordgrass Brown, *T. abeona* (Donovan) (Nymphalidae:Satyrinae) all of which are restricted in distribution, occurs in one small area around Port Macquarie in central coastal New South Wales. It has long been known (Waterhouse 1922, 1928) that this is a hybrid between *T.a. morrissi* Waterhouse (to the north) and *T.a. aurelia* Waterhouse (to the south), and is apparently maintained consistently at the boundary where these two "races" meet. Conservation of this localised form therefore depends not only on direct conservation of its swamp habitat but also on ensuring continuity of habitat with those of the parent forms. *T. abeona* is not particularly vagile, so that habitat fragmentation caused by agricultural or urban development here could mark the demise of a remarkable and

biologically unusual Australian butterfly. New (1984) cited *T. abeona* as an example of an endemic evolutionary phenomenon worthy of conservation for its scientific interest alone.

b) *Pseudalmenus chlorinda* (Blanchard) (Lycaenidae), the Australian Hairstreak, is represented by seven named forms in southeastern Australia, four of these occurring close together in Tasmania. Many are very restricted in distribution. Two Tasmanian subspecies and one mainland one have been listed as threatened. Couchman & Couchman (1977) noted that in Tasmania the Hairstreak "has been exterminated over wide areas," due to various causes. Pasture improvement, involving destruction of mature eucalypts (used for pupation sites) and acacias (the larval foodplant), and woodchipping, were cited for *P.c. conara* Couchman and *P.c. chlorinda* (Blanchard), respectively, and the Couchmans also noted the disappearance of two other distinctive but unnamed Tasmanian forms due to land clearing, burning and housing development. Soberingly, they stated that they located *P. chlorinda* in more than 50 localities after 1945 but most habitats had been destroyed so that (by 1977) it was "difficult to think of 10 areas within the island where the Hairstreak may survive." In common with many other Lycaenidae, the habitat requirements of *P. chlorinda* include the need for presence of particular species of ants in an obligate association.

Habitats

Widely recognised as the most important single requisite for conservation, habitat reservation and management has not occurred widely in Australia for butterflies alone. As noted earlier, many important vegetation types have been reduced to small remnants of their former extent, and there is considerable pressure (on non-butterfly grounds) for many of these to be reserved, with the likelihood that some butterflies will also be conserved as "passengers." Continued threats to rainforests, for example, will almost inevitably lead to loss of butterflies. Nadolny (1987) commented on significant rain forest sites in New South Wales, and the wide importance of tropical rain forests on Cape York was emphasised by Monteith & Hancock (1977). Such key sites, in a range of vegetation types, are being identified progressively in several States.

In addition to vegetation associations, ranging from alpine grasslands, and swamps to woodlands and forests, topographical features are important. Nadolny emphasised the importance of hill-topping sites for some species. Some Lycaenidae in Queensland, New South Wales and elsewhere, for example, are rarely (if ever) taken except on particular hill tops, which have become classic collecting localities and entered into Australian "butterfly folklore." One or two species are known only from such sites but, for many, it is not clear where the species breed - although the phenomenon of hill-topping may well imply that the insects gather from a considerable surrounding area, it is by no means clear whether the populations are closed or open.

The areas of habitat involved in controversy over butterfly species conservation in Australia have generally been small: for the Eltham Copper, for example, only some four ha. Samples of many Australian ecosystems are indeed included in National Parks and other reserves but for many of these areas no definitive species list of butterflies is available, and management to conserve particular rare taxa is not undertaken. Most of the lists which do exist reflect sporadic visits by collectors rather than any attempt at comprehensive survey, although a number of more rigorous surveys are in progress.

Few butterflies in Australia are regarded as "umbrella species," although this status could possibly be accorded to some alpine species, such as most species of *Oreixenica* Waterhouse & Lyell (Satyrinae), as these are very specialised forms associated with characteristic and restricted alpine herbfield/grassland communities. They are frequently abundant over their limited altitudinal ranges, and any pronounced diminution in abundance may reflect wider-reaching effects on those communities. Here, and in some other restricted habitats, Australian butterflies could be valuable as indicators of community wellbeing, and conservation of the conditions suitable for them also ensure the persistence of other, less conspicuous, sensitive alpine fauna.

The Future

There is little doubt that further degradation to the Australian environment will occur. In addition to continuing pressures for forest (including rainforest) exploitation for timber, woodland clearing, and other human interventions - including development of alpine and remote coastal sites for recreation - the ramifications of possible global warming (the "Greenhouse Effect") give cause for concern. These influences together are likely to result in further decline of many butterflies, and global warming could lead, for example, to severe contraction of alpine habitats in their present form. Decline of some butterflies will inevitably go unheralded, and insufficient is known of the biology of most of the rarer species to form the basis of informed management plans. This foundation, together with knowledge of distribution and precise taxonomic status, is gradually being strengthened, but the practical likelihood is that most species will remain as passengers in conservation activity for the foreseeable future. As elsewhere in the world, presence of rare or unusual "priority" species may strengthen the political case for reservation of particular habitats, even though they may not then be able to be managed effectively for those species. This is, perhaps, especially true for the labour-intensive maintenance of early seral vegetation stages to which many notable taxa are largely restricted, and butterfly conservationists in Australia will continue to draw on information from cases elsewhere in the world in planning optimal conservation or management strategies.

Urban reserves are becoming commonplace, as people in rapidly

expanding cities seek to conserve even small remnants of native vegetation, and restoration of these is accelerating in intensity. There is some potential for translocation of butterflies to these, though this has so far been rare. A large skipper, *Trapezites symmommus* Hubner, found to the north of Melbourne has recently been experimentally introduced to a reserve managed by La Trobe University after a habitat was prepared for it by planting of larval foodplants, and this could mark the way for other such introductions. A strong move towards preferential growing of Australian native plants in gardens is also evident, replacing the traditional concentration on exotic species, and there is some developing interest in butterfly gardening, fostered in part by horticultural groups. All these facets may help to counter the range declines and local extinctions which have caused comment from collectors in Australia since the late nineteenth century.

Public awareness of, and education on, butterflies in Australia has recently been increased through Butterfly House exhibits, predominantly in Melbourne (the Melbourne Zoological Gardens) and several tourist - based exhibits in Queensland. The latter enhance the image of *P. ulysses*, widely adopted as a tourism emblem in tropical Queensland. There is clearly considerable opportunity for conservation awareness to emanate from such ventures. Because of lack of opportunity to import live material, all such operations must depend entirely on native butterflies, and increased knowledge of their captive breeding and maintenance is a natural result of this.

A start has, thus, been made on several aspects of practical butterfly conservation in Australia. Specific cases, such as the Eltham Copper, still have considerable novelty value, and it is highly unlikely that hundreds of thousands of dollars will be made available for each of the many similar cases which may arise in the future. But more people than ever before are aware of butterfly conservation, the topic is no longer treated with universal disdain by politicians and the public, and the future for butterflies in Australia can be viewed with, at least, a reasonable level of optimism because of this increasing interest.

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Appendix 1.

Australian Butterflies listed as “threatened animals” by IUCN (1988)

Hesperiidae

<i>Antipodia chaostola leucophaea</i>	Tasmania
<i>Euschemon rafflesia</i>	E. Australia
<i>Hesperilla mastersi marakupa</i>	Tasmania
<i>Oreisplanus munionga larana</i>	Tasmania

Lycaenidae

<i>Pseudalmenus chlorinda chlorinda</i>	Tasmania
<i>P.c. conara</i>	Tasmania

Nymphalidae

<i>Heteronympha cordace comptena</i>	Tasmania
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